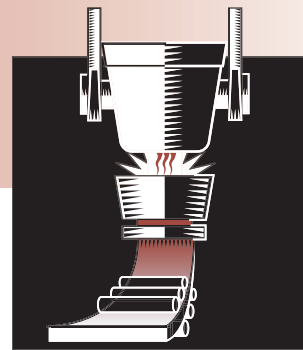


STEEL

Project Fact Sheet

ENERGY-SAVING REGENERATION OF HYDROCHLORIC ACID PICKLING LIQUOR



INNOVATIVE CLOSED-LOOP PROCESS REUSES HYDROCHLORIC ACID FROM STEEL PICKLING AND SAVES ENERGY, WASTE, AND COST FOR STEEL STRIP PRODUCERS

Benefits

- For a 40,000 gallon per day steel pickling operation (730,000 tons per year steel):
 - Savings of 166 billion Btu per year (230,000 Btu per ton of pickled steel)
 - Transport energy savings of 1.1 million gallons of fuel equaling 130 billion Btu per year
 - Savings of 10,621 tons of CO₂ per year
 - Savings in plant costs of \$1.4 million per year
 - Raw materials savings totaling \$3.3 million per year
- Enables on-site closed-loop pickling and regeneration
- Eliminates the need for transport of spent pickle liquor and off-site processing
- Cost effective for small mills for which regeneration has been too expensive
- Produces a marketable by-product

Applications

The PHAR system is designed for producers and finishing operations in the steel industry. The technology shows promise for use in 70 steel mills using hydrochloric acid in continuous processes, 90 secondary processors of steel tube and pipe, 200 galvanizing operations, and 800 wire and nail mills, representing a potential market that exceeds \$100 million.

Project Partners

NICE³ Program
Washington, DC

Connecticut Dept. of Environmental Protection
Hartford, CT

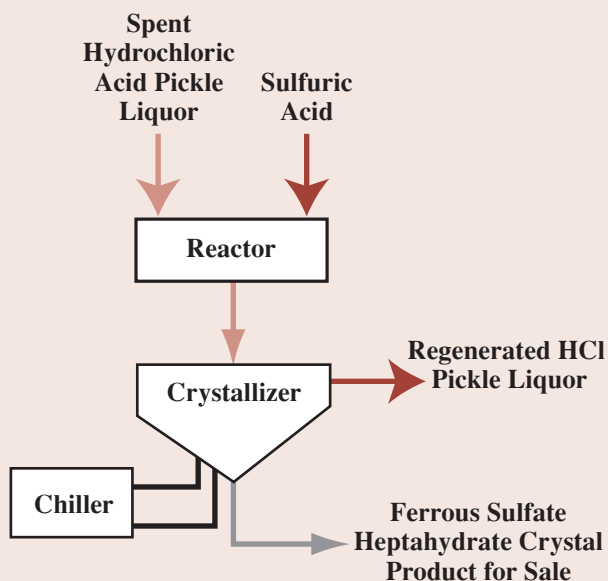
Green Technology Group
Sharon, CT

Chester Engineers
Pittsburgh, PA

U.S. Steel Group
Dravosburg, PA

Green Technology Group, with financial assistance from the NICE³ program, is demonstrating and developing for commercial use the Pickliq[®] Hydrochloric Acid Regeneration (PHAR) system, an innovative method of regenerating spent hydrochloric acid from steel pickling. Conventional pickling technology generates 1.5 billion gallons of spent pickle liquor nationwide each year, resulting in costly and energy-intensive handling, treatment, and disposal. PHAR technology eliminates the disposal problem, creating significant reductions in operating, environmental, and capital costs. The process uses sulfuric acid to restore hydrochloric acid for reuse. PHAR produces ferrous sulfate crystals (sulfate heptahydrate), an economically viable by-product, which can be sold for industrial purposes. By eliminating transportation and/or treatment of spent pickling liquor, along with costs associated with generating hydrochloric acid to replace the spent liquor solution, PHAR produces energy savings of 95%, cost savings of 52%, and a 91% reduction in CO₂, compared to existing technology.

Pickliq Hydrochloric Acid Regeneration System



Green Technology Group's Pickliq technology brings dramatic savings to the steel industry. Here, spent pickling liquor is sent to a reactor, where sulfuric acid is added to separate impurities from hydrochloric acid, so it can be reused for steel processing.



Project Description

Goal: The project, started in February 2000, hopes to demonstrate and commercialize the PHAR technology, so that energy, cost, and pollution savings can be spread throughout the steel industry. Portable prototype and full-scale pickle regeneration systems are installed at U.S. Steel Corporation's Irwin Works Sheet Mill in Pittsburgh, Pennsylvania. Commercialization of the technology will follow in 2002.

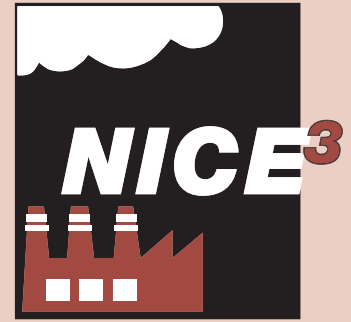
In a traditional pickling process, steel is fed through a series of processing tanks containing heated hydrochloric acid. The solution is effective in removing unwanted metallic deposits on steel until the pickling acid contains 13% iron. At this point, the spent pickling liquor is removed from the tanks at a temperature of 190°F. The solution is then either sent by truck to a certified disposal site or undergoes elaborate and expensive treatment at the plant. This expense is eliminated with the new technology, which also cuts dramatically the purchase of raw materials to produce hydrochloric acid. The new process brings additional economic benefit in the form of by-product sales of ferrous sulfate heptahydrate crystals used for industrial purposes.

The PHAR system recycles tainted hydrochloric acid/spent pickling liquor by sending it to a reactor, where sulfuric acid is added. Iron and other pickling by-products are then removed with the help of a suitable filter or centrifuge. The solution is chilled to between 10° and 30°F, causing formation of crystallized ferrous sulfate heptahydrate for easy removal from the hydrochloric acid. The purified liquid is then ready for reuse as a steel pickling agent at a fraction of the cost of replacing hydrochloric acid each time it is required. The by-product of this process, sulfate heptahydrate, is also a marketable commodity. The process does not generate wastewater or other residual wastes that would require additional treatment or disposal.

Green Technology Group is demonstrating this new technology with assistance from Chester Engineers, the Connecticut Department of Environmental Protection, the U.S. Steel Group, and the NICE³ Program sponsored by the U.S. Department of Energy's Office of Industrial Technologies.

Progress and Milestones

- Complete preliminary reporting requirements by 4/15/00.
- Outfit and install portable pilot unit by 7/1/00.
- Produce regenerated acid and conduct pickling tests by 9/1/00.
- Report on the selection of acid specs by 10/1/00.
- Purchase equipment and erect prototype by 3/1/01.
- Produce acid for full-scale test by 6/1/01, and conduct full-scale testing by 10/1/01.
- Decommission and produce final report by 1/1/02.
- Submit final report to the U.S. Department of Energy by 4/1/02.
- Commence commercialization activities.
- Report commercialization activities annually for 10 years.



NICE³ – National Industrial Competitiveness through Energy, Environment, and Economics: An innovative, cost-sharing program to promote energy efficiency, clean production, and economic competitiveness in industry. This grant program provides funding to state and industry partnerships for projects that demonstrate advances in energy efficiency and clean production technologies. Awardees receive a one-time grant of up to \$525,000. Grants fund up to 50% of total project cost for up to 3 years.

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Order # NICE³ ST-6
November 2001